Vol. VIII No. 2 June 1956

DIRECTORATE OF PLANT PROTECTION, QUARANTINE AND STORAGE
MINISTRY OF FOOD AND AGRICULTURE, GOVERNMENT OF INDIA

PLANT PROTECTION BULLETIN

SCIENCE IN PRACTICE

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NOTE

This Bulletin is intended to disseminate information about plant protection measures and campaigns adopted or conducted in different parts of India as well as about the advances made in the field of plant protection in other parts of the world, to the extent possible. It is also intended to give information about the latest developments in the production of pesticides, plant protection equipment and techniques of pest and plant disease control. Elaborate scientific papers on Entomology or Plant Pathology or on the chemistry of pesticides would normally not be in place in this Bulletin but short notes dealing with the behaviour or distribution of pests and plant diseases and brief reports on their epidemiology, control, etc., would be welcome. Plant protection has now become such a specialised science and yet is so diversified and consequential in its character and application that it is difficult to define the scope of the subject with any great precision. The general rule to be observed is that any information which can be useful in preventing or controlling damage to crops, fruit trees, plantations and stored agricultural commodities, caused by pests and diseases, should be a fit subject for publication in this Bulletin.

Manuscripts submitted for publication in the Plant Protection Bulletin must be typed in double spacing on one side of the paper only, leaving ample margin on the left, at the bottom and on the top of the page. Photographs or drawings must be accompanied by a clearly typed legend for being reproduced under them. In addition, they should bear, on the reverse, in clear handwriting in pencil, the name or names of the author or authors and the article which they illustrate. Local names of insects, diseases, weeds, crops and plants, if used, must be commenced with a small, not capital, letter and underlined and must invariably be followed by their scientific or well known English names. Localities or place names should be clearly indicated by reference to well known districts or States or both.

While this Directorate will take every care to include only such material in the Bulletin as may be considered reasonably correct and useful, it can accept no responsibility for every statement made and every opinion expressed. Due to various unavoidable reasons, the appearance of this Bulletin has been far behind the scheduled time. While this is greatly regretted, every effort would be made to avoid delays in future. Those who may read this Bulletin are invited to offer criticisms and suggestions for its improvement.

K. B. LAL

New Delhi

PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA

THE DIRECTORATE OVER A DECADE

By

K. B. Lal

Plant Protection Adviser to the Government of India, New Delhi.

In May 1956, the Directorate of Plant Protection, Quarantine and Storage completed 10 years of its life, having been established in May 1946 under the Ministry of Food and Agriculture, with headquarters at New Delhi. Earlier in October 1945, a Plant Protection Adviser to the Government of India (Dr. H. S. Pruthi) had been appointed, who was designated as *ex-officio* Director of the organisation. Subsequently, the *ex-officio* designation was shed and the Head of the Directorate was designated as 'Plant Protection Adviser to the Government of India and Director, Locust Control'.

The Directorate started with the following main functions :—

(*i*) To organise campaigns against such pests and diseases of all-India importance as locusts and rusts, in collaboration with the State authorities.

(*ii*) To prevent the entry into India of new pests and diseases carried on plant materials imported by sea, air and land routes.

(*iii*) To regulate, with the co-operation of the State authorities, the inter-State movements of plants and plant materials so as to prevent the further spread of pests and diseases to new areas in the country.

(*iv*) To regulate the import of parasites and predators for the control of pests.

(*v*) To generally assist the States in carrying out field operations against pests and diseases by providing timely information about their outbreaks.

(*vi*) To advise about the proper storage of grains, seeds and other agricultural commodities in villages and in markets by farmers and traders.

The first task of the Directorate was to build up a Central plant-protection organisation and simultaneously to induce and assist State Governments in setting up more or less similar organisations within their respective territories. Punjab and Uttar Pradesh were the first to follow suit and thereafter other States also established their plant protection organisations. Large-scale campaigns against pests and diseases began to be organised and pesticides distributed to farmers at subsidised rates under the Grow More Food schemes of the Government of India. New pesticides, such as BHC, DDT, aldrin, dieldrin, chlordane, Parathion, Toxaphene, copper fungicides, organo-mercuric compounds, zinc phosphide and methyl bromide, as well as new spraying and dusting machines, operated by hand, foot and power, were being constantly tested for their field performances and put into use all

over India. In these developments, the Directorate had naturally to play important roles by itself testing them or arranging for the tests by State organisations and by disseminating information about them. Meanwhile, with the extension of areas of cultivation, adoption of new farming practices, increasing use of new crop varieties and fertilisers, better irrigation facilities and developments in communications and air traffic, new pests and diseases began to appear and those that were relatively unimportant before assumed importance. New problems were, therefore, set for the Directorate and for the State plant protection organisations.

The developments in plant protection, not only in India but all over the world, and force of circumstances led to a re-orientation of the functions of the Directorate, gradually, almost imperceptibly. More and more the Directorate became as much an action as an advisory agency. The States required of it not merely technical advice but also material assistance to fight pest and disease outbreaks, which were becoming frequent and which could not be allowed to go uncontrolled as in the past. International obligations in relation to desert locust control and plant quarantine created new 'action' duties for it. The activities of the Directorate, therefore, developed in the following main directions :—

Locust Control

The Government of India having assumed direct responsibility for locust control in the desert area (Scheduled Desert Area), as distinct from other areas, called 'cultivated areas' for convenience of reference, for which the concerned State Governments were responsible, the implementation of the responsibility naturally fell to the Directorate. The Locust Warning Organisation, which had been created in 1939 on a permanent basis under the then Imperial Entomologist, was transferred to the Directorate in 1946. The partition in 1947 necessitated the re-building up of a locust control organisation in the desert area of the new India, extending over a total of about 82,000 square miles in the States of Rajasthan, Bombay, PEPSU and Punjab. This area was divided into three Circles, with headquarters at Jodhpur, Bikaner and Palanpur, which were again sub-divided into zones, with headquarters at different places whose number fluctuated from 8 to 12. Each of the zones had a number of Outposts attached to it, the total number of which varied from 20 to 90, depending on the locust situation and activity.

Considerable quantities of insecticides and considerable numbers and varieties of transport vehicles, spraying and dusting machines, wireless sets and other equipment were added to the resources of the Directorate, chiefly during 1953—56. Various tests and trials were made in the field to develop and improve locust control techniques, the most notable of which was the spraying of locust-infested grounds with aldrin. For a variety of reasons, the Directorate discarded the method of poison-baiting, which, even till 1953, was considered as about the most effective and economical method of locust control. World opinion subsequently recognised the value of dusting and spraying also, as at least equally satisfactory methods.

Two notable developments occurred during the locust plague of 1950—55. One was the initiation of a Co-ordinated Anti-locust scheme, under which the States, vulnerable to locust attacks, contributed to the costs of the anti-locust campaigns in the Scheduled Desert Area, undertaken by the Directorate by expanding its Locust Warning Organisation. The contributions were fixed on the basis of cultivated areas in the States and their

distance from the Rajasthan desert. The second was the employment of aircraft in locust control and for the first time in the control of any pest in India and, indeed for any agricultural purpose. An attempt at reconnaissance work by means of a chartered plane in 1950 unfortunately proved abortive, the plane crashing after a couple of flights. However, in 1951, 1952 and 1953, three fixed-winged planes (Piper Cubs) were obtained for about 2-3 months each year under the Point IV Programme of Technical Assistance of the U.S.A. Government, which sprayed locust hoppers and adults with aldrin over a total area of approximately 27,865 acres in Rajasthan. In 1954 aerial spraying against locusts was again carried out in Rajasthan and near Nagpur over a total area of about 6,942 acres by Piper Supercruisers under an arrangement with the Hind Provincial Flying Club of Lucknow.

Locust Plagues.—The locust plague of 1940—46 had just subsided when the Directorate was established. However, a new locust cycle started in India in 1950 and continued till 1955. The numbers of swarms, which came into India from the west, were approximately 36 in 1950, 56 in 1951, 109 in 1952, 136 in 1953, 175 in 1954 and 16 in 1955. About half a dozen swarms developed in Bombay and Rajasthan States during the autumn of 1950. During 1951 and 1954, the swarms travelled as far east as Assam and as far south as Hyderabad and Bombay States. The year 1954 was the worst year of the plague, when gregarious breeding took place in Rajasthan, Bombay, Delhi, Ajmer, Punjab, PEPSU, and western Uttar Pradesh, over a total gross area of over 68,000 square miles. By this time, locust control work had been mechanised to the extent of about 80 per cent and dusting with BHC and spraying with aldrin by a large variety of hand—and power-operated machines as well as by aeroplanes were largely the methods employed. The total value of the crops damaged in different parts of India was estimated to be about Rs. 2.07 crores against Rs. 10 crores, which was the value of the estimated damage during the 1926—31 locust plague. When it is remembered that the prevailing price rates during 1950—55 were at least four times of those during 1926—31, the comparable damage during the former period was really of the value of about Rs. 52 lakhs. There is no reason to believe that the locust plague of 1950—55 was of lesser intensity than in 1926—31 and, therefore, the obvious conclusion is that the comparatively insignificant damage during the former period was due to the developments achieved in locust control organisation, resources and techniques.

Locust Investigations.—Although *ad hoc* investigations, connected with locust control, had been undertaken by the Directorate, it was realised early in 1954 that in order to effectively combat the pest, not only control techniques needed to be constantly developed and tested in the field but information about locust populations, breeding and behaviour under varying conditions of environment must also be gathered, studied and utilised to improve anti-locust measures. The extensive series of researches, carried out in the undivided India from 1931 to 1939 under the Indian (then Imperial) Council of Agricultural Research, had provided valuable information and data but not much sustained work thereafter had been done. The researches also had been undertaken during a period of locust inactivity in India. It was also appreciated that, if the survey, intelligence and reporting services provided by the permanent Locust Warning Organisation were to be fully utilised, provision must be made for sustained and continued locust investigations, specially in the field. A Locust Research Unit was, therefore, set up in the Directorate and a programme of work

drawn up by a Committee, consisting of Dr. B. N. Uppal, Agricultural Commissioner to the Government of India, Dr. M. L. Roonwal, Forest Entomologist, Forest Research Institute, Dehra Dun, Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, and Dr. K. B. Lal, Plant Protection Adviser to the Government of India and Director, Locust Control. Some of the items of the programme were assigned to Dr. Roonwal for study at Dehra Dun and some to Dr. Narayanan for study in his Division, and the rest were taken up in the Directorate at Bikaner. The work under Dr. Roonwal is progressing but that at the I.A.R.I. has been discontinued from the 1st April, 1956. The work at Bikaner is continuing. Meanwhile a scheme for the establishment of a Field Station for Investigations on Locusts at Bikaner has been included in the Second Five Year Plan as one of the three schemes of the Directorate.

International Collaboration.—Although India had participated in international meetings, convened to discuss problems of locust control, even before, it was with the establishment of the Directorate that organised collaboration with other countries was developed. Under an Anti-locust Convention, signed in 1947, representatives of India, Pakistan and Iran have met in annual conferences in Tehran (1948), Karachi (1949), New Delhi (1950), Tehran (1954) and New Delhi (1955), which facilitated exchange of locust information and development of control techniques and measures. The Conferences in 1950 and 1954 were attended by representatives and experts of various other Governments also and of the F.A.O. In 1953 three officers of the Directorate, with some equipment, assisted in locust control work in Iran. In 1955 and 1956, anti-locust missions, consisting of 28 and 30 officials, respectively, with insecticides and equipment, were deputed to Kuwait and Saudi Arabia to participate in international campaigns against the desert locust in the Arabian peninsula, organised by the F.A.O.

Plant Quarantine

The Destructive Insects and Pests Act, 1914, and the various notifications issued under it, provided the basis of plant quarantine work in India, which was being handled by the Customs authorities, with the co-operation of concerned State Governments, at certain prescribed sea-ports. The technical adoption of quarantine measures was, however, recognised to be the responsibility of the Directorate with the initiation of this work under it at Bombay sea-port in October 1949. A building for the Station was constructed later and formally declared open on the 25th December 1951. Meanwhile, a Plant Quarantine and Fumigation Station was established at Madras sea-port in June 1950, which, starting with the fumigation of imported American and West Indies cotton as a safeguard against the cotton boll weevil, took over the entire work of plant quarantine in 1953. On the 1st January 1955, the Station moved into its new double-storeyed building at the northern end of the Madras Harbour. This was followed by the establishment of a Plant Fumigation Station at Amritsar airport in August 1954 with the chief object of fumigating fruits and vegetables imported into India from Afghanistan and other countries. A similar Station was established at Cochin sea-port in August 1955 to facilitate the import of American and West Indies cotton.

International Collaboration.—As much as, if not more than, locust control, plant quarantine has been recognised to be a matter of international collaboration and the Directorate was called upon to play its part in this field also. In 1952 the Government of India signed the International

Plant Protection Convention of 1951, sponsored by the F.A.O. Earlier in. March 1949, the Deputy Director, Plant Diseases, (the Late Dr. B. B. Mundkur) participated in an international phytosanitary conference, held at Singapore. He was followed by the Plant Protection Adviser (Dr. H. S. Pruthi), who was deputed to a similar conference in Singapore in April 1949, convened to discuss 'steps to be taken for setting up a Phytosanitary Convention in South East Asia'. In December 1954, the Plant Protection Adviser (Dr. K. B. Lal) participated in a meeting, convened by the F.A.O., to discuss measures against the introduction of dangerous pests and plant diseases into the South East Asia and Pacific Region, in particular the leaf blight disease of *Hevea* rubber from the American tropics, and to draft an international Agreement for the purpose. This Agreement was sponsored by the F.A.O. in 1956 for ratification or adherence by the countries concerned and in June 1956 the Government of India had decided to sign it. In September 1955 Dr. K. B. Lal, Plant Protection Adviser, was permitted to serve on a committee of nine specialists, appointed by the F.A.O., to advise it about plant quarantine, in particular, about the various provisions of the Plant Protection Agreement for South East Asia and Pacific Region.

Expansion Programme.—A scheme for the expansion of plant quarantine facilities has been included in the Second Five Year Plan, under which are proposed: (*i*) the development of the Fumigation Station at Cochin sea-port into a Plant Quarantine Station and (*ii*) the establishment of Plant Quarantine Stations at the sea-ports of Visakhapatnam and Kandla and at the airports of New Delhi, Bombay, Madras and Calcutta. The establishment of Plant Quarantine Stations at two or three places along the Indo-Pakistan border in the Punjab, at the Calcutta sea-port and at Amritsar airport is also proposed on the basis of schemes included in the First Five Year Plan.

Plant Protection

Although locust control and plant quarantine are also plant protection, it is convenient to refer to some other aspects of it under this general heading. The Directorate's work on the trials of various pesticides, rat control, biological control of the cottony cushion scale in south India (1946—1950), storage of food grains and other agricultural commodities, control of wheat and barley rusts in south India (1948—1951) by prohibiting the summer cultivation of these crops, seed treatment against seed-borne diseases of cereal crops and seed potato certification are described in some details in the 5-year report (1946—1951) issued by the Plant Protection Adviser to the Government of India in 1953.

During the years following 1951, field trials of pesticides have been continued and the field performance of various types of spraying and dusting machines has been under assessment. It has been increasingly realised every where that the mere suitability of a pesticide is no guarantee of success against a pest or a disease unless it is properly applied. Attention to application equipment has, therefore, assumed importance. There has been in use in India a large variety of spraying and dusting machines of varying degrees of utility, ranging from very small hand sprayers and dusters to large machines operated by power, including mist blowers, low volume sprayers and fog generators. In view of the need to introduce standardisations and improvements in them as well as to determine schedules for maintenance and performance tests, a Specialist in plant protection

machines is to be shortly assigned to the Directorate for about nine months under the Expanded Technical Assistance Programme of the F.A.O.

Flying foxes are very destructive to growing citrus, apple, peach, guava, coconut and other fruits in many parts of India, notably the Punjab. The Directorate has conducted some trials with small bombs which, when fixed to the trees on which the flying foxes are roosting and ignited by means of a fuse at some distance from the trees, bring down the animals in large numbers, which may then be killed. The method is still in the experimental stage.

Aerial Unit.—The use of aircraft in locust control has already been mentioned. During 1955 and 1956, a Piper Supercruiser was employed to spray Endrin against the Pyrilla pest of sugarcane over several hundred acres each year near Bhopal. In view of the growing importance and possibility of aerial spraying and dusting of crops, the Government of India have decided to establish an Aerial Unit of three fixed-wing aeroplanes (two Beavers and one Auster Auto Car) under the Directorate. To assist in the setting up of this Unit and also to train some Indian pilots, the services of a Pilot Specialist are being obtained this winter for about nine months under the ETAP of the F.A.O.

Central Plant Protection Stations.—During the past 4 or 5 years, there have been many demands on the Directorate for material and practical assistance for fighting pest and disease outbreaks in the various States, for example, *gundhy* bug of paddy in Bihar, 1952, rat control in Uttar Pradesh, 1953, wheat rusts in Madhya Pradesh, 1956. It has been appreciated that in many such cases the resources, available with the State Governments, are not adequate and that regional stocks of pesticides and control equipment, together with some technical staff, should be very helpful in emergencies, which are occuring more frequently than perhaps ever before. In addition, regional training programmes for plant protection staff should greatly improve the standard and utility of plant protection work all over the country. To meet such and other requirements, it has been decided to establish under the Directorate a chain of fourteen Central Plant Protection Stations in different parts of the country, under a scheme of Central Pool of Plant Protection Equipment, in parts accepted under the First and the Second Five Year Plans. Six of such Stations have already been established.

Biological Control.—Another notable development, sponsored by the Directorate, has been an Agreement between the Governments of India and Canada in 1954 under the Colombo Plan, as a result of which a regional Station of the Commonwealth Institute of Biological Control, Ottawa, is being established at Bangalore. The Canadian Government have contributed 38,340 dollars for the construction of a building for the Station and its equipment as well as for the salaries of a secretary and guard for a consecutive total of 50 months and the Government of India have provided a site for the Station, with a compound wall around it, and the services of an Indian Entomologist for 18 months. The building of the Station has been nearing completion and in June, 1955, Dr. V. P. Rao, Assistant Director, Plant Quarantine, in the Directorate, was assigned to the Station at Bangalore as the Indian Entomologist. The Canadian Government also provided a Biological Control Specialist (Mr. W. F. Sellers), concurrently assigned to India and Pakistan, for assisting in the establishment of the Biological Control Stations at Bangalore and Rawalpindi, respectively.

DEVELOPMENT OF FUNGICIDES IN RELATION TO PLANT PROTECTION

By

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Introduction

Plant diseases cause considerable loss to economic crops every year. In recent years there has been a keen desire on the part of cultivators to take up timely remedial measures to avert serious crop losses due to diseases. At present there is a vast literature on the development of various chemicals used for the control of plant diseases. In this paper a short account is given of the trend of development of different groups of fungicides and the various recently developed proprietary products that are now in popular use for plant protection work in the Madras State.

Copper group

Dusts

The two compounds of copper *viz.*, Copper carbonate and Cuprous oxide were the important fungicides used as seed protectants. The basic Copper carbonate was first used in 1902 but it was not until its use by Darnell Smith in 1917 that it came to be widely employed as a seed dressing fungicide. The value of cuprous oxide as a seed protectant was first reported in 1932 and soon it was found to have some value as a foliage spray also. The dust was used to prevent seed decay and damping off of vegetable seeds.

Although some dusts, like Cuprocide, with Cuprous oxide as a base have been developed in subsequent years they could not withstand competition against organo-mercurials as seed protectants. The copper compounds have not made much progress and are not, therefore, much valued as seed disinfectants.

Sprays

As sprays, this group had monopoly in the field of plant protection for several years. The following preparations were in common use till the advent of the fixed or insoluble copper compounds in recent years.

(*a*) *Bordeaux mixture.*—This best known and most widely used copper fungicide is prepared by mixing a solution of Copper sulphate with milk of lime. This mixture, when prepared properly in correct proportions, is highly effective against several fungus diseases. The fungicidal action is due to the formation of soluble copper in atmospheric moisture, which is toxic to spores or sporelings. The method of preparing the mixture is rather tedious and when correct proportions of lime and Copper sulphate are not used the resulting mixture will be of inferior quality and at times even phytotoxic. Further, it should be prepared fresh every time and the unused mixture has to be discarded. Certain crops like apple and pears are extremely sensitive to Bordeaux mixture and this has led to the search for other materials.

(*b*) *Burgundy mixture.*—As there was difficulty in procuring a suitable supply of good quality lime for the preparation of Bordeaux mixture, soda (Sodium carbonate) was substituted in the place of lime. A mixture containing 4 lbs. of Copper sulphate, 5 lbs. of washing soda and 50 gallons of water was prepared, which is now called 'Burgundy mixture' from the district in which it was first employed. It never came into wide use, although it was as effective as Bordeaux mixture in fungicidal value, because of its spray injury on the foliage.

(*c*) *Cheshunt compound.*—Attempts to improve upon Bordeaux mixture were numerous between 1885—1930. A number of products of various combinations of Copper carbonate and Ammonium hydroxide and Ammonium carbonate under the name 'Cuprammonium' compounds came into use but were discarded as unsuitable. But one compound belonging to this group *viz.*, Cheshunt compound was used for some time. A mixture of two parts of Copper sulphate and eleven parts of Ammonium carbonate, ground ready for solution, was suggested by Johnson in 1890. The ground mixture is stored in stoppered bottles for 24 hours before use and one ounce of the mixture in two gallons of water is used with a rose-can for drenching the soil. Johnson's mixture was recommended for the control of damping off disease.

(*d*) *Colloidal copper.*—This was yet another copper compound in popular use for some time. This compound had certain advantages over Bordeaux mixture as the stock solution could be stored for 2-3 months. A stock solution of one gallon was prepared by the addition of 5 ounces of caustic soda in 3 pints of water into a solution containing 1 lb. of Copper sulphate and 1 pint of molasses in 4 pints of water. The spray fluid was prepared, when required, by diluting the stock solution to the desired concentration. This preparation was found to leave little stain on the foliage when sprayed and was also used as a soil drench against certain soil-borne pathogens. It was not popular as it was found to be less efficacious than Bordeaux mixture and other compounds.

To avoid copper injury and to obviate the tediousness of preparing the mixture every time, there followed a series of copper compounds which as a class are commonly referred to as "Insoluble" or "fixed" coppers. The decided advantage of this group is that they do not require the addition of lime. These are copper salts that readily go into suspension with water. They contain about 50% copper in the form of Cuprous oxide, Copper oxychloride or basic Copper sulphate. They are ordinarily evaluated in relation to one another on the basis of percentage of metallic copper. Since they are less phytotoxic they are preferred to Bordeaux mixture in many instances, especially on sensitive foliage, where lower fungicidal value is offset by lower phytotoxic injury. Some of these products have been found to be particularly effective against specific diseases. The following are some of the fungicides that are marketed, at present, under different trade names and are being used for plant protection work in Madras State.

Cupravit Coppesan Shell copper Wetcol-15 Cuprokylt Blitox	These are copper fungicides having about 50% copper in the form of Copper oxychloride and are used in the place of Bordeaux mixture.

Perenox Fungi copper Fungimar Copper Sandoz	These products contain about 50% copper in the form of Cuprous oxide.
Zincop	This is a copper fungicide having about 42% basic Copper sulphate as its active ingredient.

For preparing the sprays, a small quantity of the fungicide is first stirred into a little water to form a solution, free from lumps, and then the required quantity of water is added, stirring constantly until the desired concentration is obtained. These are generally used at the rate of about 2—5 lbs. in 100 gallons of water, depending on the nature and intensity of the disease.

Among the fungicides stated above, Cupravit, Wetcol-15, Fungimar, Fungi copper, Shell copper, Zincop and Coppesan have been certified to be effective by the Government Mycologist, Coimbatore. while others are under test.

Sulphur group

The value of sulphur as a fungicide was known prior to the scientific study of fungi against which it is used. Sulphur dust came into use as a fungicide, especially against powdery mildews, in the first half of 19th century. Its use was greatly extended in Europe for the control of powdery mildew (*Uncinula necator*) of grapevine. As a fungicide, sulphur was used originally as flowers of sulphur consisting of small crystals produced by sublimation. But it was soon discovered that the more finely divided the sulphur particles were, the better was the protection obtained. At present, sulphur is marketed in finely ground particles which can pass through at least a 325-mesh sieve and there is a definite trend towards the use of very finely divided sulphur. The sulphur compounds now in use may be divided into three main groups, *viz.*, sulphur dusts, lime sulphur and wettable sulphurs.

Sulphur Dusts

Fine sulphur in its natural state occurs in deposits of volcanic origin in many parts of the world. The crude sulphur so obtained is not fit for use and it has to be micronized before it can be used as a fungicide. Sulphur dusts are made from finely divided elemental sulphur and the dusts should be capable of passing through at least a 325-mesh sieve. Sulphur is not poisonous but may cause severe eye inflammation and, therefore, protective goggles should be worn when the dust is applied. Sulphur may also be phytotoxic, causing burning, stunting and defoliation under certain circumstances. It is widely used against powdery mildews and also as a seed dressing fungicide against grain smut of *Sorghum*. It is effective against cereal rusts but is not used on large scale, primarily for economic reasons.

Lime Sulphur

When Bordeaux mixture was found to cause phytotoxic injuries on certain crops like apple, peach etc., attention was diverted towards other spray materials. Lime sulphur was suggested by Grison in 1852 as an

efficient remedy for powdery mildew of vine. It was later on introduced into America. In 1905, Cordley introduced a mixture of Calcium polysulphides obtained by boiling sulphur and lime in water. The material proved to be exceptionally good against the apple scab fungus, *Venturia inaequalis*. It was widely used as a fungicide on fruit trees for a long time. But in course of time it was found that lime sulphur was disagreeable and harmful to foliage, especially when temperatures were high. Therefore, it is being gradually replaced by other types of sulphurs and also by new organic fungicides.

Wettable Sulphurs

These are at present widely used as substitutes for lime sulphur as they are safer on foliage. They are finely divided sulphurs combined with wetting agents to allow them to form fine suspensions in water. The following are some of the wettable sulphurs that are now marketed under different trade names and are also used for plant protection work in Madras State.

Sofril Ultra sulphur Spersul Fernasul Thiovit Solbar	These are wettable sulphurs containing finely divided sulphur in combination with wetting agents. They are mainly used against powdery mildews at concentrations specified by the manufacturers. In preparing the spray, a thin paste is made with a little quantity of water and then diluted to obtain the desired concentration. The spraying should be done only in the mornings or late in the evenings and not in dry, hot weather.

Organic fungicides

Till about 1930, only a few products of copper, sulphur and mercury were used as fungicides for the control of plant diseases. The experiments and researches were mainly concerned with finding out the proper time of application, the number of applications and the quantities to be applied rather than with the development of fungicides. Further, some of the fungicides were found to be phytocidal to certain crops. To overcome these defects, investigators in this field have explored the possibilities of producing other materials and, as a result, a series of new organic fungicides have been developed in recent years. The organic fungicides now in use may be divided into two groups, *viz.*, the organic mercurials and the non-mercurial organics.

Organic Mercurials

Organic mercurials were the first to figure under organic fungicides. The highly toxic action of inorganic Mercuric chloride led to a search for a number of derivatives. These are mainly used as seed dressing fungicides for cereals, legumes, cotton and other field crops, and are found to be particularly effective against seed-borne diseases of cereals. The first record of their use was in 1914 when Chlorophenol mercury was reported to be successful against wheat seed for the control of bunt. But it was not until the beginning of World War II that organic foliage sprays came into the picture. The development of organo-mercury seed disinfectants has

been entirely due to the activities of the interested commercial concerns in Europe and the credit for introducing mercury compounds for fungicidal treatment goes to Germany. A series of compounds under different trade names, Ceresan, Agrosan, Granosan, Germisan, etc., have been released and among them Ceresan 2% (Ethyl mercury chloride) was the first organic mercurial widely used as a seed protectant. It was followed and largely replaced by New Improved Ceresan (5% Ethyl mercury phosphate). Ceresan M (7.7% Ethyl mercury p-toluene sulfanilide) appeared later, replacing the previous two products. Simultaneously, the commercial firms in different parts of the world, particularly the American concerns, have taken up the work of manufacturing and improving the existing fungicides and, as a result, several organo-mercury compounds have appeared in the market. The following are some of the most important ones that are commonly used for fungicidal treatments.

Agrosan GN	..	(1.5% Phenyl mercury acetate + 0.5% Ethyl mercury chloride)
Aagrano	..	(3.5% Ethyl Propyl mercury bromide)
Ceresan M	..	(7.7% Ethyl Mercury p-toluene sulfanilide)
Leytosan	..	(7.2% Phenyl mercury urea)
Panogen	...	(2.2% Methyl Mercury Dicyan diamide).

Besides these, there are a number of other organo-mercury compounds like Atiran, Certosan, Harvesan, Tillex etc., that have been tested and found to be quite effective as seed protectants against cereal diseases. Among the fungicides tested under South Indian conditions, Agrosan GN and Ceresan were found to be the best and hence they are recommended for seed treatment in this State. The majority of the organo-mercurials, besides affording effective protection against seed-borne fungi, have yielded increased germination percentage of seed, and also better stand and vigour of seedlings than are found in untreated seed under identical conditions. These proprietary products contain very small quantities (less than 5%) of organically combined mercury as active ingredient in a fine state with good adhesive and covering properties. They are highly poisonous and, therefore, must be handled with due care. The workmen engaged in seed dressing operations, especiallyin closed sheds, should protect the nose and mouth with suitable masks. Hands should be thoroughly washed after the work is over. The treated seed should not be used either for human consumption or as cattle feed. Hence it is very desirable to treat the quantity of seed just required for sowing purposes only.

Non-Mercurial Organic Fungicides

With the outbreak of World War II, considerable difficulty was felt in obtaining adequate quantities of mercury, copper etc., and their scarcity gave a strong impetus to the search for and development of other organic fungicides. Further, it was reported that some of the mercurial seed dressings were not suitable for certain vegetables and that they were also highly poisonous to human beings handling them. In order to overcome these defects and to make up for the deficit of other metallic compounds required for the manufacture of fungicides, attention was diverted to the

development of organic fungicides. The new fungicides have increased in number since 1945 and a wide array of such products is now available in the market. These new products are good against specific diseases, although they do not serve as a general purpose fungicide like Bordeaux mixture. As a rule they are less injurious to seeds and less poisonous to persons handling them. Further the ease with which they could be prepared for use and the absence of clogging of nozzles of the sprayers are added advantages contributing to their wise-spread use and popularity. The organic sulphurs and quinones are prominent ingredients in these compounds and are often combined with phenol, chlorine, bromine, Quinoline, zinc, copper, iron, sodium or other materials. Many of these have proved highly effective in the control of several diseases and an immense potential demand exists for these products. The majority of the newer organics may be divided into the following categories, *viz.*, dithiocarbamates, chlorinated quinones and naphthaquinones, Quinolinolate derivatives, glyoxalidine derivatives and dinitro compounds. Among these, only the derivatives of dithiocarbamates and chlorinated quinones and naphthaquinones have come into popular use in the Madras State at present.

(*a*) *Dithiocarbamates.*—These consist of a number of non-corrosive and relatively non-poisonous compounds that are effective against a wide range of fungus diseases. They are mainly protectants and do not have long residual effect and, therefore, require repeated applications under epiphytotic conditions. They are available as wettable powders, dusts and water-miscible liquids. Zinc, iron and sodium salts of dithiocarbamic acide constitute the majority of formulations. The following are some of the products that are in use for plant protection work in the Madras State.

Dithane Z-78 (65% Zinc ethylene bisdithiocarbamate),

Dithane D-14 (Disodium ethylene bisdithiocarbamate),

Zerlate (Ziram) (Zinc dimethyl dithiocarbamate),

Fermate (Ferbam) (Ferric dimethyl dithiocarbamate).

Dithane Z-78 has given very effective control of early blight of potatoes in the Nilgiris. This is a light yellow powder which mixes readily with water to form a highly suspendable spray that does not clog or corrode spray equipment. This is used at the rate of 1½ lbs. in 100 gallons of water. This is a product of Rohn and Haas Co., Pennsylvania, U.S.A.

(*b*) *Chlorinated Quinones and Naphthoquinones.*—The commercial fungicides sold under the trade names Spergon, Phygon, etc., belong to this group. They are available in the form of wettable powders for use as foliage sprays as well as in the form of dusts for some seed treatments. They are relatively safe to handle. These have been reported to be particularly suitable as seed protectants for vegetables that are adversely affected by organo-mercurials. Spergon and Phygon have also been tested against seed-borne diseases of paddy and found to be effective.

Spergon (Tetrachloro-p-benzoquinone) 98% chloranil .

Phygon (2, 3 Dichloro-1, 4-naphthoquinone) 50% of the chemical +50% of talc).

PLANT DISEASES IN ANDAMAN ISLANDS AND THEIR CONTROL

By

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Introduction

A survey of Andaman Islands was carried out by the author and Shri M.V. Venkatesh, Technical Assistant (Entomology), from 17th September to 6th October, 1955, for studying the major diseases and pests of crops and assessing the need for a plant protection organisation in these Islands. The problem of plant diseases in the Islands has been summarised in this article.

The Andaman Islands are situated in the Bay of Bengal and consist of a group of about 200 islands. The more important of these are the North, South and Middle Andamans. The total area of the Andaman Islands is 2,508 sq. miles. In the North and South Andamans the coast line is highly indented and the terrain is hilly. A wide belt of mangrove land is found around many parts of the Islands. Besides, there are rich forests extending almost to the coast.

Climate

The climate of the Islands is tropical. The mean maximum temperature varies between 83°F and 89° F and the mean minimum between 71° F and 75° F. There is very little variation in temperature during the year. The average annual rainfall in North Andamans is about 75″ with about 100 rainy days in the year, while in South Andamans it is 123 with about 150 rainy days. From May to December there are frequent rains, the sky remains completely overcast during June, July and August. From January to April the weather is dry. The relative humidity remains high throughout the year, the average during the dry months being 74—78% and during the rest of the year 81—90%.

The soil is generally poor in available phosphoric acid, but fairly rich in organic nitrogen.

Crops and areas under cultivation

The main agricultural crop is paddy, of which there are about 11,000 acres under cultivation. Others in order of importance are :—

Coconut	..	3,655 acres
Rubber	..	430 acres
Banana	..	Grown as kitchen garden crop.
Cashewnut	..	106 acres, scattered
Coffee	..	37 acres

Mangosteen	..	8 acres
Miscellaneous fruits and vegetables	..	Grown as kitchen garden crops

The main agricultural land under cultivation is in the South Andamans but new forest areas are now being cleared in other islands as well and more land is being brought under cultivation.

Disease incidence

The crop-wise disease incidence in various localities of the North, South and Middle Andamans, at the time of survey was as follows :—

Paddy.—The crop was mostly in the vegetative stage. A very light infection of sesame leaf spot, *Helminthosporium oryzae* and of the leaf smut, *Entyloma oryzae* was observed in South Andamans, at Humphreyganj, Craikabad, Toosanabad, Manpur and Colnipur.

In Middle Andamans, in the newly developed colonization areas, *viz.*, the Rangat block, a trace or very light infection of *Helminthosporium oryzae* was noticed. Besides, there were a few suspected cases of *Sclerotium oryzae*. In Bakultala block, in Shamkund, a very light infection due to false smut, *Ustilaginoidea virens* was noticed.

Sugarcane.—At the Government experimental farm in Port Blair, a few rows of this crop had been sown for demonstration purposes. The crop was lightly infected by red rot, *Physalospora tucumanesis* Speg. (*Glomerella tucumanesis*). Midrib infection with typical *acervuli* was observed. Besides, the perfect stage of the red rot fungus was noticed on older leaves of several plants, this being the first record from the Andaman Islands. Rust due to *Puccinia kuehni* was also noticed on some plants. The infection was very mild and confined to the leaf sheaths. Only the uredial pustules were observed.

Jowar.—A few plants were raised in Shamkund in Middle Andamans. These were severely infected with the rust *Puccinia purpurea* covering over 65% of the leaf area.

Vegetable.—Vegetables are not grown on a large-scale in the Islands. Here and there a few vegetable crops were noticed in very small plots.

A light to moderate infection of collar rot of chillies *Sclerotium rolfsii* was observed. Brinjals were lightly infected with the leaf spot, *Alternaria solani,* lady's finger with *Cercospora hibisci* and beans with *Cercospora dolichi.* The tomato crop was attacked by root nematodes. Besides, several vegetable crops were affected by damping off, *Pythium aphanidermatum.*

Coconut.—At Rangachand, South Point, Mithakhari, Port Muoat, Haddo, Carbines Cove, Mini Bay, Bamboo Flat, Rose, Viper and Long Islands a light to severe infection of *Pestalotia palmarum* and traces of the stem bleeding disease, *Thielaviopsis paradoxa* were noticed.

Rubber.—There are about 430 acres under this crop at Wimberleyganj, in South Andamans. These plantations are very old and rather neglected. The plants had almost 100% infection of die back, *Botryodiplodia theobromae* and pink disease, *Corticium salmonicolor.* Besides, root diseases and *Phytophthora* disease of the tapping pannel were also reported. The flowering plant parasite *Loranthus* sp., was noticed on several plants.

Coffee.—A few acres of Liberian coffee were noticed near Humphreyganj in South Andamans. The plantations were in a neglected state. The rust, *Hemileia vastatrix* was common throughout, but of light intensity.

Citrus.—The canker, *Xanthomonas citri* and the wither-tip, *Colletotriclum gloeosporioides*, were common in the South, Middle and North Andamans and the Long Island. These were, on an average, of moderate intensity in the Islands. Besides, gummosis and leaf and fruit fall, possibly due to *Phytophthora palmivora*, were noticed on a few plants in the South Andamans. Sooty-mould, *Meliola butleri* was also present in a light to moderately severe form.

Mango.—Die-back was common throughout the Islands. Besides, leaf-spot, *Pestalotia* sp., and sooty-mould, *Capnodium* sp., were also present.

Papaya.—A few papaya trees in the Government horticultural farm Port Blair, were infected with foot-rot *Pythium aphanidermatum*. At other places the plants were healthy.

Jack fruit.—There was a mild attack of *Rhizopus artocarpi*. The young inflorescences were affected.

Banana.—Fruit-rot, due to *Gloeosporium musarum* was reported, but the disease was not observed at the time of the visit.

Cashewnut.—This was infected with die-back, *Pellicularia salmonicolor* the disease was fairly common.

Forest trees.—Forests comprise over 95% of the total area of the Islands. The following trees were reported to be of commercial importance.

Garjan	*Dipterocarpus* spp.
Badam	*Terminalia procera*
White *chuglam*	*T. biflata*
Red *dhup*	*Parishia insignis*
Papita	*Sterculea campanulata*
Didu	*Bombax insignis*
Bahotta	*Endospermum malaccense*
White *dhup*	*Canarum euphyllum*
Lamba pati	*Sideroxylon longepetiolum*
Black *chuglam*	*Terminalia mani*
mohwa	*Mimusops littoralis*
Lal bamboo	*Artocarpus chaplash*
Toungpeing	*Artocarous chaplash*
Pyenima	*Lagerstroemia hypoleuca*
Thingan	*Ropea odorata*
Padauk	*Pterocarpus dalbergioides*
Marblewood	*Diospyros marmorata*
Satinwood	*Murraya exotica*
Koko	*Albizzia lebbeck*

Several wood-rotting fungi, *viz.*, *Polystictus* sp., *Stereum* sp., *Daedalea flavidu*, *Polyporus gilvus* and *Fomes fastuosus* were reported.

Weeds

Throughout the Islands, *Eupatorium* sp., *Cyperus* spp., *Strobilanthus* sp., and *Mimosa pudica* were the common weeds which were particularly abundant in the newly-cleared forest areas.

Lichens and Algae

Lichens were very common on mango, citrus, coconut and jackfruit plants while *Cephaleuros* sp., was common on mango.

Control measures

Due to moderate temperatures and high humidity, the climate of these Islands is favourable for the rapid development of diseases. Their incidence is, therefore, normally high. The following control measures are suggested against the various diseases of importance :—

Crop	Disease	Control Measures
Paddy	Seedling blight and sesame leaf, spot, *Helminthosporium oryzae.*	1. Seed-treatment with Agrosan GN, Ceresan or other organo-mercury fungicides for surface disinfection of seed. 2. Spraying the nursery beds with copper fungicides.
Vegetables	Damping off, *Pythium aphanidermatum.*	1. Seed-treatment with organo-mercury fungicides or with quinone derivatives, *viz.*, Spergon, Phygon, etc. 2. Treatment of nursery beds with cheshunt compoud.
	Leaf spot (various causes)	Spraying the crop with copper fungicides, (*viz.*, Bordeaux mixture, Perenox, Yellow Cuprocide, Copper Sandoz, etc.), or organic fungicides (Dithane D-14 or Dithane Z-78, etc.).
Citrus	Canker, *Xanthomonas citri*	1. Removal and burning of diseased twigs.
	Die back and wither-tip, *Colletotrichum gloeosporioides*	2. Spraying with 0·8 to 1% Bordeaux mixture or other copper fungicides.
	Gummosis, leaf rot and fruit fall, *Phytophthora palmivora*	3. In case of gummosis, removal of gum pockets and application of Bordeaux paste.
Mango	Die back	Pruning of and burning the affected twigs and spraying with Bordeaux mixure 5 : 5: 50 or Perenox 0·35% (with Albolineum as a sticker) or other copper fungicides and application of tar or Bordeaux paste to the cut ends.
Coconut	Stem bleeding disease, *Ceratostomella paradoxa*	Excision of affected parts and application of tar or Bordeaux paste on the exposed surface.
	Root diseases and die-back, *Botryodiplodia theobromae*	1. Application of lime to the infected soil after removal of the diseased plants.

Crop	Disease	Control Measures
		2. Removal and burning of diseased and dead twigs and application of Bordeaux paste to cut surface.
Rubber	Leaf-blight, *Phytophthora palmivora*	Spraying with Bordeaux mixure (5: 5: 50) or other copper fungicides.
	Pink diesase, *Corticium salmonicolor*	Excision of affected parts and application of Bordeaux paste to the forks and cut ends.

In addition to the adoption of regular control measures against diseases and pests, certain quarantine measures are also necessary. Seed and planting materials of different crops are being imported from the mainland both through Government agencies and through private parties. It is likely that new diseases may be introduced into these Islands. For instance, there is the possibility of introducing the bunchytop and chlorosis of banana from Travancore-Cochin, Bombay or Orissa, where these diseases are prevalent and from where plant propagating material might be imported. There may be other instances of a similar nature.

It may be observed that the following difficulties are peculiar to these Islands :—

(1) For 8 to 9 months in a year there are frequent rains and strong winds. As such, spraying and dusting are not always possible and proper timing for carrying out these operations will have to be worked out for maximum efficacy. Besides, suitable stickers etc., will be necessary for use along with the pesticides.

(2) The Islands are separate units and there are difficulties of regular transport etc. Communication through motor-boats is not very frequent and proper roads do not exist.

(3) There are yet no facilities for boarding and lodging for the agricultural staff in the newly-developed colonies and the plant protection workers find no suitable place for camping.

(4) In the newly-cleared forest areas, the fields are over-grown with weeds. Besides leeches, mosquitoes and sand flies are common. These present considerable difficulty in carrying out field work. Special efforts will, therefore, be necessary to adopt plant protection measures successfully.

To fight the menace of pests and diseases, a plant protection scheme drawn up by the Plant Protection Adviser to the Government of India has been approved by the Government of India. The control of pests and diseases should now be a regular activity of the local Agricultural Department.

Acknowledgment

Thanks are due to Shri S. M. Maitreya, Chief Commissioner, Andaman and Nicobar Islands for providing facilities for a survey of the various crops in the Islands, and to Shri Barpujari, Agricultural Officer and Shri Kurpad, Coconut Development Officer, for kindly accompanying us to various places in the Islands.

CONTROL OF FOOT ROT OF *PAN, PIPER BETEL* L., IN UTTAR PRADESH

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In several districts of Uttar Pradesh *pan* (*Piper betel* L.) is an important cash crop, but its cultivation is often rendered unecomonical by the ravages of the foot rot and leaf spot diseases. In the early stages the leaves show some black spots, which later extend all over the surface. Ultimately, the infection reaches the stem, which also turns black and rots, leading to the death of the whole shoot. Another type of stem infection starts at the base near the ground and rapidly kills the whole plant within a few hours.

Experiments on the control of this disease were carried out in several *bhitas* (*betel* vineyards) of *pan* in the Banaras district. The following table shows that spraying with a cuprous oxide product, *e.g.*, 0.3% Perenox, checks the disease appreciably. Subsequent incidence of the disease is reduced if cultivation in the same field is stopped for two consecutive seasons.

Table I

Effect of fallowing and spraying with a cuprous oxide product on foot rot of pan

Sown after 2 years fallow.			Sown for the second year in succession.		Sown for the second year in succession and sprayed with Perenox.	
Sample No.	Total vines	Diseased vines	Total vines	Diseased vines	Total vines	Diseased vines
1.	46	4	37	12	23	..
2.	29	3	35	15	30	1
3.	49	3	20	20	26	1
4.	45	3	21	21	32	..
5.	43	4	21	21	34	..
6.	29	..	17	15	25	..
7.	42	..	15	12	15	2
8.	30	..	21	17	30	..
9.	32	..	29	21	23	2
10.	26	2	30	22	17	..
Total	371	19	246	176	255	6
Per cent infection		5·1%		71·6%	..	2.3%

Sometimes, mismanagement of pan *bhitas* leads to predisposing factors for the recurrence and spread of the disease. It is, therefore, suggested that keeping *bhitas* excessively shady, addition of gram and pea flour to soil, continuous cropping and use of bamboos and other hatching material from the diseased *bhitas*, should be avoided.

THE GRAM CATERPILLAR, A SERIOUS PEST OF *JOWAR* IN MADRAS STATE

By

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Fletcher (1914) recorded redgram (*Cajanus indicus*), Bengal gram (*Cicer arietinum*), groundnut, tomato, maize, tobacco, *ganga* (*Cannabis sativa*), linseed, safflower and lab-lab as the crops coming under the host range of the gram caterpillar, *Heliothis* (*Chloridea*) *obsoleta* F. Ayyar (1940), while adding cotton to the above list, recorded it only as a minor pest of this crop in Coimbatore. The object of this note is to place on record the increased ravages of this pest on *jowar* (*Sorghum vulgare*) in different parts of the Madras State, during recent years.

The pest occurred in an epidemic form for the first time in July, 1953, on *jowar* in the Palladam taluk of Coimbatore district. An area of over five hundred acres of this crop, which was nearing harvest, extending in a belt from Anuparapatti village to Palladam, was threatened with total extinction. In this part of the Madras State, *jowar* is generally grown as a dry crop during April—July, the preceding crop invariably being cotton. The former is usually raised as a mixed crop with green gram (*Phaseolus mungo*), black gram (*P. radiatus*), field bean, and horse gram (*Dolichos biflorus*). The practice of raising *jowar* soon after a crop of cotton and growing it along with other host plants of the gram caterpillar has, probably, given sufficient scope for the pest to acclimatise and establish itself. During the outbreak, almost every earhead in an infested field had the caterpillars in various stages of growth, nibbling and feeding on tender grains, their number varying from five to fifteen in most cases. The caterpillars showed characteristic colour variations, ranging from a velvety black, when they were young, to yellowish green, when they were about to pupate. An infested field could easily be spotted out by the chalky appearance of the earheads due to the presence of partially eaten grains. The control of this pest is difficult, particularly on this crop, owing to the concealed nature of its habitat inside the compact earheads.

Experiments were undertaken to find out a satisfactory measure of control of the pest. Sprays of BHC 0.1% (gamma), DDT 0.2%, Toxaphene 0.1% and dusts of BHC 10% (1.3% gamma) and DDT 10% were tried. Treatments with DDT at a high dosage (at about 60 gallons of the spray fluid or 20 lbs. of the dust per acre) gave the best results and completely controlled the pest in the course of 48 hours. The treatment costs about Rs. 7 to 10 and has become quite popular amongst the farmers.

At present, the incidence of the gram caterpillar is quite common throughout the Madras State, on *jowar*, cotton, castor, all varieties of pulses, and a host of other plants as well, thus posing a serious problem to the Plant Protection organisation.

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SHORT NOTES

(*i*) Grass hopper *Acorypha* sp. assuming the status of a pest in Ajmer and adjoining areas in Rajasthan (India)

During 1949-50, the author observed a grasshopper, subsequently identified as *Acorypha* sp. (sub-family *Catantopinae* of Acrididae), which assumed the status of a serious pest of feed and fodder crops in Ajmer (Rajasthan).

Acorypha sp., does not seem to breed in the cultivated areas. *Birs* or grasslands adjoining cultivated and forest areas appear to be its main and permanent breeding grounds. The hoppers are very active and travel long distances and sometimes invade even the residential dwellings of villagers. They move in small bands, from their original breeding areas (grasslands and forest areas) into the cultivated areas. The adults and hoppers are found mostly on the surface of the soil except for a short while when they feed on plants or grasses. At a rough estimate nearly one lakh acres were infested by this pest in Ajmer alone.

In the cultivated areas, the young hoppers feed on the seedlings of maize and sesamum, while the advanced stage and adult grasshoppers damage the sesamum flowers, cut the top shoots of cotton and feed on the buds and bolls. In addition, flower buds of *urid* (*Phaseolus mungo*) and *mung* (*Phaseolus radiatus*) are also seriously damaged. As the activity of the pest continues up to the beginning of *rabi* season, it causes severe damage to the germinating wheat, barley and gram, which are important food crops of the region.

Control.—Direct dusting of the hoppers and adults with 5% BHC was effective, but when it was done on the crops it did not have much effect, the pest being a surface inhabitant on the soil. The following bait proved very successful :—

Saw dust	1 maund
BHC 10%	2 seers
Gur	3 seers
Water	Sufficient to make a crumbling mass.

The bait was spread at the rate of 30 lbs. per acre.

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(*ii*) Grain Smut of *Jowar*

Jowar tops the list of cultivated crops in Hyderabad State. It is sown as a *kharif, rabi* and lightly irrigated crop in the black soils of Marathwada and Karnatak, and light *chalka* soils of Telangana regions.

Among the many important diseases causing loss to the *jowar* crop, grain smut, (*Sphacelotheca sorghi*) is the most important. It occurs every year and in certain localities nearly 50 per cent of the earheads are lost. This is locally called *kani, katiga* or *kajli.* It causes nearly 10 per cent loss to the total production of jowar, amounting to nearly 1½ crore rupees.

The further spread of the grain smut of *jowar* can be checked to a large extent by picking out and destroying the smutted earheads in the field as well as in the threshing yard. However, the simplest and cheapest method of control is by treating the seed with sulphur dust before sowing.

Sulphur dust is distributed by the extension staff of the Department. If improved seed is distributed, it is thoroughly mixed with sulphur dust in a seed mixer or any suitable vessel at the rate of 4 ozs. per 112 lbs. of seed. Sulphur packets of 2, 4 and 8 ozs. are sold by the Department.

During the past 5 years of Grow More Food activity, the distribution of sulphur has been done on a large-scale throughout the State. The figures given below indicate the acreage under the treated seed and the estimated gain in yield due to the control of the disease.

Year		Acres under treated seed	Gain in yield in maunds
1950-51	..	6,39,600	1,99,875
1951-52	..	13,22,560	4,13,250
1952-53	..	24,25,728	7,58,040
1953-54	..	32,78,442	10,24,206
1954-55	...	34,42,325	10,75,416

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(*iii*) EARLY BLIGHT OF POTATO

Early Blight, *Alternaria solani,* is the most important disease of potato in the State. Late blight (*Phytophthora infestans*) occurs very rarely and does not cause much damage. Spraying with 5 : 5 : 50 Bordeaux mixture or Perenox at the rate of one pound in 32 gallons of water has given excellent control of early blight.

During 1951—54, a control campaign was organised in Medak and Bidar districts, where potato is grown extensively. With the co-operation of the cultivators, 600, 800 and 451 acres of potato crop were sprayed during 1951-52, 1952-53 and 1953-54 respectively. This measure has been so successful that the cultivators are taking up the control themselves.

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(*iv*) An unusual incidence of *Dacus* species on sann hemp Plants

In May 1953, in the course of survey and pest control in Delhi, it was observed that a few rows of sann hemp plants bordering the fields of melon (*Cucumis melo*) and *tinda* (*Citrullus vulgare*) harboured a number of *Dacus* flies whereas the melon and *tinda* crops showed comparatively negligible numbers of them. There were in all about 1,440 sann hemp plants under observation, ranging from ½ to 2 feet in height. A nearby *ber* tree (*Zizyphus jujuba*) was also seen having a number of these flies resting under its leaves.

The flies were active amidst the sann hemp plants and were observed to settle on the under-surface of the leaves. The average number of flies for 20 plants was 3.5, the minimum observed being one and the maximum eight. Occasionally, some of the plants had no flies on them. An analysis of collections by an insect net by sweeping it over the sann hemp plants at random, revealed that as many as seven to eight flies per set of three sweeps were trapped, the minimum being three and the maximum twelve. The flies thus collected consisted of two species, *viz.*, *Dacus ciliatus ciliatus* Loew. and *Dacus cucurbitae* Coq., in the ratio of 7 : 1.

The number of fruit flies collected in the melon fields was between zero and two per three sweeps of the net, while counts of insects in two random rows (about 60 plants each) revealed that there were 16 adults of *D. ciliatus ciliatus* and two of *D. cucurbitae*, indicating almost the same proportion as observed on sann hemp plants.

Out of the *Dacus ciliatus ciliatus* collected on sann hemp, 88% (23 out of 26) consisted of males, but among those collected in the melon field, out of eight flies there were three males and three females of *D. ciliatus ciliatus* and the remaining two flies were a male and a female of *D. cucurbitae*.

It appeared that the flies on the sann hemp plants were seeking the honey dew of the cotton jassid (*Empoasca devastans D.*) and thrips, on which they fed, besides the protection afforded to them by the crop.

As soon as the temperature rose up in the first week of June, the population of the fruit flies declined suddenly on the sann hemp plants under observation. After a thorough search, *D. ciliatus ciliatus* was found to take shelter under some sann hemp plants in the shade of some trees near a well, till the onset of rain in July, but *D. cucurbitae* was not seen anywhere in the area surveyed.

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NEWS AND NOTES

Conference of Central and State Ministers of Agriculture

The Ministry of Food and Agriculture, Government of India, convened a conference of Central and State Ministers of Agriculture, at Mussoorie, Uttar Pradesh, from 28th to 30th June, 1956. The object of the Conference was to consider the scope for raising the targets of agricultural production, developmental measures needed for the achievement of higher targets and financial outlays involved in each, and certain other matters relating to agricultural commodities and the integration of activities concerning agricultural production. The conference was presided over by Shri A. P. Jain, Union Minister for Food and Agriculture.

The Conference adopted a number of resolutions, of which the following related to Plant Protection :—

(1) All State Governments should take adequate steps to intensify plant protection work and extend it to cover much larger areas than was possible during the First Plan period, in order to achieve an increased production of at least one million tons of food grains.

(2) To attain this an additional provision of Rs. 1.9 crores be made for pesticides in the plant protection schemes of the State Governments.

(3) All State Governments should make pesticides easily available to cultivators at subsidized rates.

(4) Plant Protection Organisations should embark on a regular system of training of plant protection and other extension workers in the correct methods of pest and disease control. In addition, mobile plant protection squads going round the country-side and imparting some elementary training to cultivators be organised.

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